

REMARKS

Claims 1-35 are pending in this application. By this amendment, new claims 31-35 are added. Claims 27-30 are withdrawn from consideration.

A. Restriction Requirement

Applicants confirm that a provisional election was made on February 25 to prosecute Group I, claims 1-26. This election was made with traverse. New claims 31-35 added by this amendment also correspond to Group I and therefore also should be examined.

Applicants respectfully submit that each of claims 1-35 is sufficiently related that the subject matter of one of the groups of claims would necessarily encompass the subject matter of the other group of claims. That is, as described below, the examined claims generally relate to a predetermined solder pattern and a visual appearance of a heated predetermined solder pattern being indicative of whether solder is lead-free. Claims of Group II include similar subject matter. For example, independent claim 27 (of the non-elected group) recites an identifying solder pattern formed on a second pad where the identifying solder pattern visually indicates whether solder used to form the identifying solder pattern is lead-free. This claim therefore is very similar to the subject matter of Group I being examined and searched. Further, as discussed below, independent claim 27 defines patentable subject matter over the applied reference. It is respectfully submitted that each of the groups of claims includes similar features that should be examined simultaneously in order to avoid duplicative efforts on the part of the Patent Office and undue burden on the applicants.

MPEP §803 clearly states that:

if the search and examination of an entire application can be made without serious burden, the Examiner must examine it on the merits, even though it includes claims to independent or distinct inventions.

It is respectfully submitted that this policy should apply in this application to avoid unnecessary Patent Office examinations and undue burden on the applicants.

Applicants respectfully request that each of claims 1-35 be examined in this application.

B. Rejections Based On Applied Art

The Office Action rejects claims 1, 2, 6, 7-10, 12, 14-17, 19, 21 and 23 under 35 U.S.C. § 102(b) by U.S. Patent 6,123,248 to Tadauchi et al. (hereafter Tadauchi). The Office Action also rejects claims 3-5, 11, 13, 18, 20, 22 and 24-26 under 35 U.S.C. §103(a) over Tadauchi. The rejections are respectfully traversed.

Embodiments of the present invention relate to a method and structure for identifying lead-free solder in printed circuit boards. As discussed in the present specification, it may be necessary to identify lead-free boards over the life/death of the boards. See page 4, lines 11-16 of the present specification. For example, a predetermined pattern from a stencil may be screen printed onto a pad during a solder paste printing process that applies solder paste. This may create a corresponding predetermined pattern on the pad. See Figure 3B's "LF" pattern (or character symbols) that indicates the circuit board is lead-free. The solder on the printed circuit board may be heated in an oven to create a normal solder reflow process. The solder pattern on the pad may later be visually examined to determine if the solder is lead-free based on the amount of reflow of the solder on the pad. See page 5, lines 1-11 of the present specification. For example, Figure 3D shows the shape of the "LF" character symbols

after reflow using lead-free solder. One may visually recognize the symbols representing lead-free after reflow if the solder is lead-free. In contrast, Figure 3E shows the shape of the "LF" character symbols after reflow when using lead based solder. That is, the solder mass corresponds to a glob-like shape. Figures 4D and 4E also show the "LF" character symbols after reflow using lead-free solder and lead solder respectively. Still further, Figures 5A-5C show a technique of distinguishing between lead solder and lead-free solder on a printed circuit board using visual indicators 102, 104 and 106 provided along a pad 100. This enables any person to determine whether the board is lead-free or not. See page 9, line 15-page 10, line 8 of the present specification.

Applicants initially note that the Office Action does not address the specific features of each of the claims. That is, the Office Action merely asserts:

One observes than when Pb is present in the alloy a film of Lead Oxide is formed so that when the solder is placed onto a substrate the [the] [L]ead-containing solder will flow relatively easily. Whereas when there is a Tin-Zinc there is stronger film formed and this film hinders molten solder from contacting the base material. (CF. Col. 5). It would have been obvious to place solder through at least one stencil aperture and onto a pad of a Pcb since this is old and hence obvious in this art.

Independent claim 1 recites placing a predetermined solder pattern onto a pad and heating the predetermined solder pattern where a visual appearance of the heated predetermined solder pattern being indicative of whether the solder is lead-free.

Tadauchi does not teach or suggest at least these features of independent claim 1. Tadauchi has no suggestion where a visual appearance of a heated predetermined solder pattern is indicative of whether the solder is lead-free. That is, Tadauchi merely describes that if solder is a tin-lead solder, then a metal oxide film is formed thereon. See Tadauchi's column 5, lines 25-27. In contrast, in a zinc-containing solder, a strong zinc oxide film is formed. See col. 5, lines 32-35. Tadauchi then describes that the molten solder is placed in a non-oxidizing environment until it contacts with the base material in order to prevent oxygen from contacting the solder and forming a metal oxide film. See col. 5, lines 38-42. That is, while Tadauchi describes the use of a tin-lead solder and a zinc-containing solder, Tadauchi does not teach or suggest a visual appearance of the heated predetermined pattern being indicative of whether the solder is lead-free. That is, there is no suggestion of a visual indication of a difference between the tin-lead solder and the zinc-containing solder. At best, Tadauchi merely describes a strong film for a zinc-containing solder and a metal oxide film formed on a tin-lead solder. This is no suggestion for a visual appearance of a predetermined solder pattern being indicative of whether solder is lead-free or not. The mere fact that a zinc solder forms a stronger film does not teach or suggest a visual appearance of a heated predetermined solder pattern being indicative of whether the solder is lead-free. Thus, independent claim 1 defines patentable subject matter.

Each of independent claims 9, 19, 23, 27 and 33 defines patentable subject matter for at least similar reasons as independent claim 1. That is, independent claim 9 recites placing solder on a pad and heating the solder to cause reflow as well as a visual appearance of the heated solder being indicative of whether the solder is lead-free. Independent claim 19 recites receiving the printed circuit board having a heated

solder pattern formed thereon and identifying whether solder on the printed circuit board is lead-free based on whether the heated solder pattern is substantially similar to a predetermined solder pattern. For similar reasons as set forth above, Tadauchi does not teach or suggest identifying whether solder is lead-free based on whether a pattern is substantially similar to a predetermined solder pattern. That is, Tadauchi merely describes films being formed prior to being placed within an non-oxidizing environment. This not identifying whether solder is lead-free based on whether a heated solder pattern is substantially similar to a predetermined solder pattern. Independent claim 19 defines patentable subject matter at least for this additional reason.

Independent claim 23 recites receiving the printed circuit board having a heated solder pattern formed thereon and identifying whether solder on the printed circuit board is lead-free based on a distance the solder reflows. Tadauchi does not teach or suggest any type of identification of lead-free solder based on any distance that solder re-flows. Thus, independent claim 23 defines patentable subject matter for at least this reason.

Independent claim 33 recites determining that the solder is lead-free if the predetermined solder pattern after heating is in substantially a same pattern as the predetermined solder pattern before heating. For similar reasons as set forth above, Tadauchi does not teach or suggest these features.

Although in the non-elected Group, independent claim 27 recites an identifying solder pattern formed on a second pad where the identifying solder pattern visually indicates whether solder used to form the identifying solder pattern is lead-free. For similar reasons, Tadauchi does not teach or suggest these features.

For at least the reasons set forth above, each of independent claims 1, 9, 19, 23, 27 and 33 defines patentable subject matter. Claims 2-8 and 31 depend from claim 1, claims 10-18 and 32 depend from claim 9, claims 20-22 depend from claim 19, claims 24-26 depend from claim 23, claims 28-30 depend from claim 27 and claims 34-35 depend from claim 33 and therefore define patentable subject matter at least for this reason.

In addition, the dependent claims also recite features that further and independently distinguish over the applied references.

For example, dependent claim 3 recites that placing the predetermined solder pattern comprises passing solder through at least one stencil aperture and onto the pad. See also dependent claim 11. Tadauchi does not teach or suggest the formation of any predetermined solder pattern based on a stencil aperture. The Office Action asserts that it would have been obvious to place solder through at least one stencil aperture and onto a pad since this is old and obvious in the art. Applicants respectfully disagree that this feature is known along with the other features. Therefore, if the Patent Office maintains the rejection of claim 3 and other claims related to a stencil aperture, then the Patent Office is requested to provide a prior art reference showing these features in combination with the other claimed features as well as provide motivation to make the combination.

Dependent claim 4 (and similarly dependent claims 4, 13, 20, 28 and 34) recites that the predetermined solder pattern comprises at least one symbol. Tadauchi does not teach or suggest the predetermined solder pattern including at least one symbol as recited in dependent claim 4. Additionally, dependent claim 5 recites that placing the predetermined solder pattern includes placing solder at one end of an indicator strip.

Tadauchi does not teach or suggest the indicator strip as recited in dependent claim 5. See also dependent claims 18 and 24.

Dependent claim 6 recites examining the heated predetermined solder pattern to determine if the solder is lead-free. Dependent claim 7 recites visually identifying whether the predetermined solder pattern after heating is in substantially a same pattern as the predetermined solder pattern before heating. Additionally, dependent claim 8 recites that examining the heated predetermined solder pattern includes determining whether an amount of reflow is greater than a predetermined amount. Tadauchi does not teach or suggest these respective features of dependent claims 6-8. See also dependent claims 14-16 and 21-22. That is, Tadauchi does not suggest examining a predetermined solder pattern to determine if it is lead-free. Tadauchi also does not suggest identifying whether a pattern is substantially a same pattern before heating as after heating. Still further, Tadauchi does not suggest determining whether the amount of reflow is greater than a predetermined amount. The Office Action never addresses these features, and therefore applicants are unable to comment on the Office Actions' interpretation.

Still further, dependent claim 31 (and similarly dependent claim 32) recites that examining the heated predetermined solder pattern includes determining that the solder is lead-free if the predetermined solder pattern after heating is in substantially a same pattern as the predetermined solder pattern before heating. Tadauchi does not teach or suggest these features as Tadauchi does not determine if solder is lead-free based on a pattern before or after heating.

For these reasons set forth above, it is respectfully submitted that each of claims 1-35 defines patentable subject matter. Withdrawal of the outstanding rejections are respectfully requested.

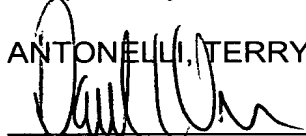
CONCLUSION

In view of the foregoing, it is respectfully submitted that the above-identified application is in condition for allowance. Favorable consideration and prompt allowance of claims 1-35 are respectfully requested.

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Respectfully submitted,

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